

## Ch 15-16 Notes G.ink

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Ch 15/16 Acids/Bases

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Ch 15/16 Acids/Bases  
General Props of Acids/Bases

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Acids

Bases

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Ch 15/16 Acids/Bases

General Props of Acids/Bases

Acids  
low pH - (Below 7)

Bases  
high pH (Above 7)

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Ch 15/16 Acids/Bases

General Props of Acids/Bases

Acids

low pH - (Below 7)

give off  $H^+$  ions in soln

Bases

high pH (Above 7)

give off  $OH^-$  ions in soln

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electrolytes

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Ch 15/16 Acids/Bases

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change color of indicators

Bases

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Δ color of indic.



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Litmus Red in Acid  
Blue in Base

phenolphthalein

↳ colorless in Acid  
pink in Base

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Bitter taste

feel slippery

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3 Def's of Acids/Bases

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Arrhenius (Traditional Def)

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Acids

any compound that contains H  
and gives off  $H^+$  ( $H_3O^+$ ) in aqueous  
soln



## Ch 15-16 Notes G.ink

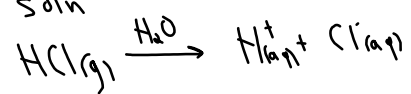
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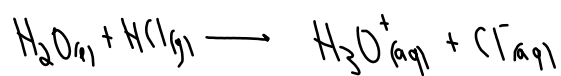
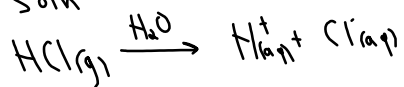
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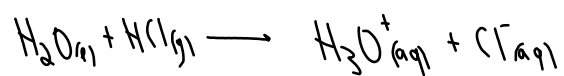
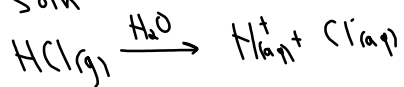
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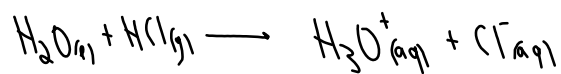
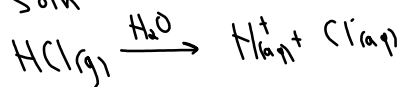
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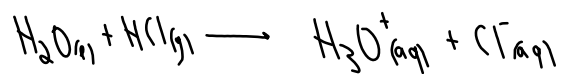
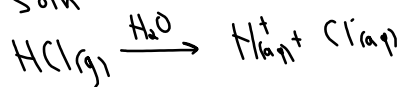
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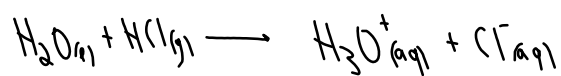
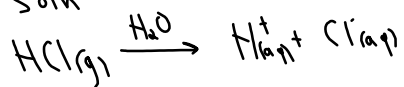


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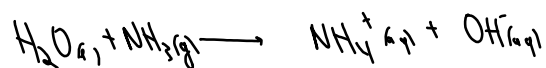
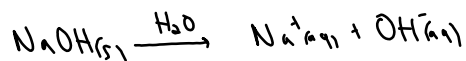
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Acid

any species that is  
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Base

any species that  
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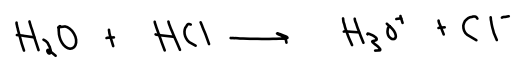
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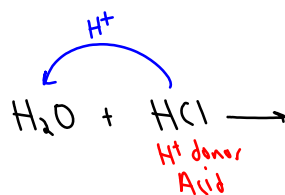
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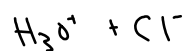
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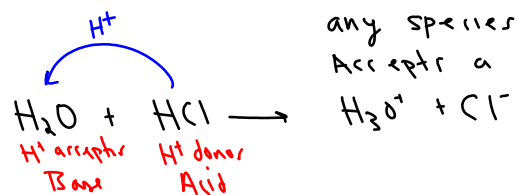
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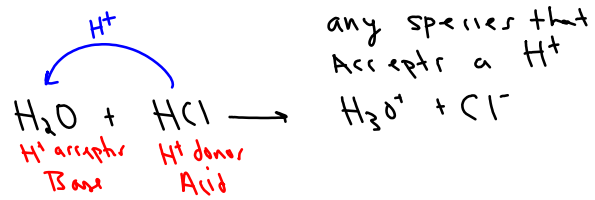
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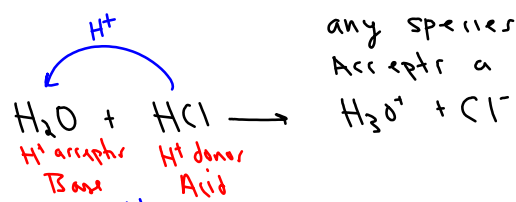
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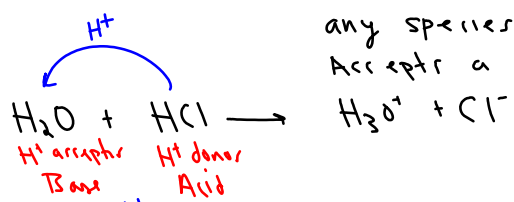
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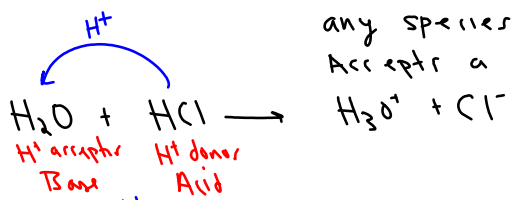
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#### amphoterism

↳ species can  
be either an acid  
or a base

#### Base

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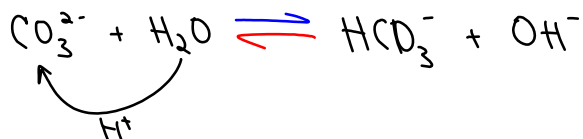
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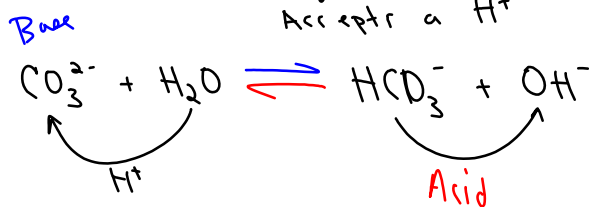
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Lewis Definition

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Lewis Definition

Acid

Base

Lewis Definition

Acid

$e^-$  pair acceptor

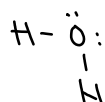
Base

$e^-$  pair donor

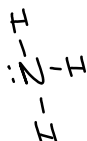
Lewis Definition

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+



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Lewis Definition

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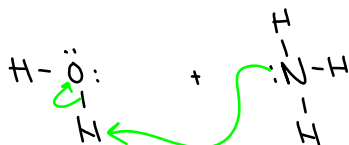
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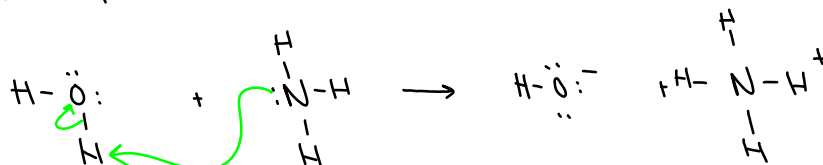
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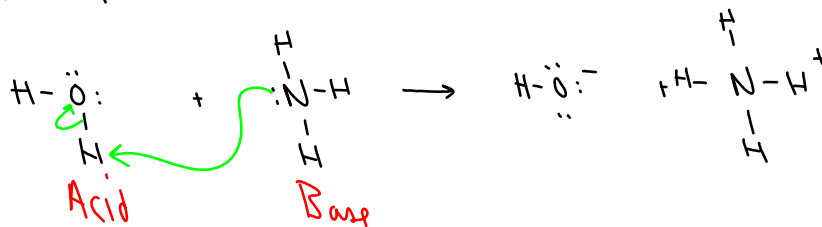
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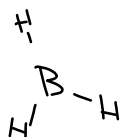


Boron Trihydride

## Ch 15-16 Notes G.ink

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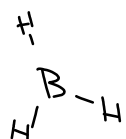
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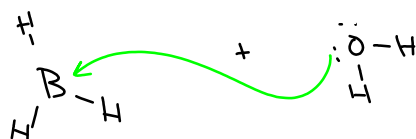
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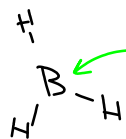
+



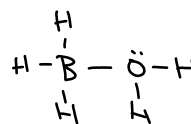
Boron Trihydride



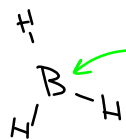
Boron Trihydride



+



Boron Trihydride

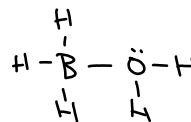


Lewis A

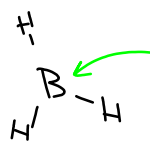
+



Lewis B



Boron Trihydride

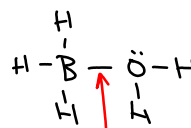


Lewis A

+



Lewis B



coordinate covalent bond  
↳ e<sup>-</sup> pair in a bond comes  
only from boron



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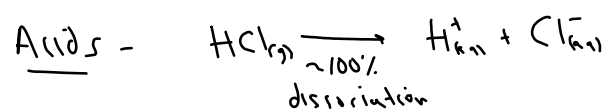
Strengths of Acids/Bases

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"Strong" → ionize nearly completely

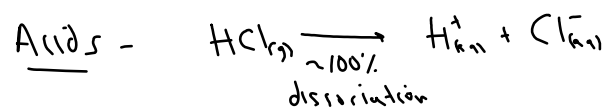
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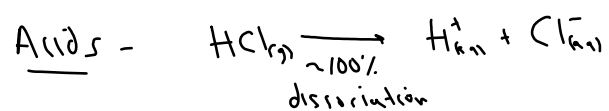
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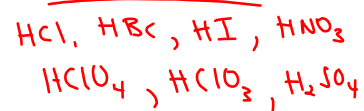


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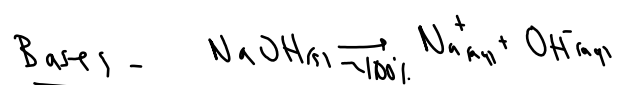
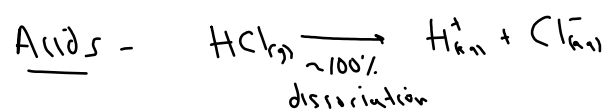


7 Strong Acids

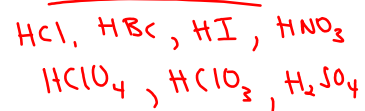


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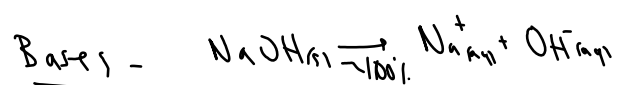
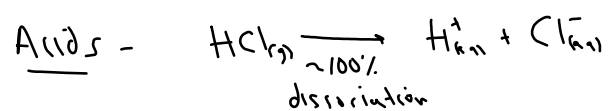


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Strengths of Acids/Bases

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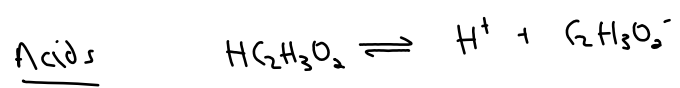
$\text{HCl}$ ,  $\text{HBr}$ ,  $\text{HI}$ ,  $\text{HNO}_3$   
 $\text{HClO}_4$ ,  $\text{HClO}_3$ ,  $\text{H}_2\text{SO}_4$

Gr 1+2 Metal  
hydroxides

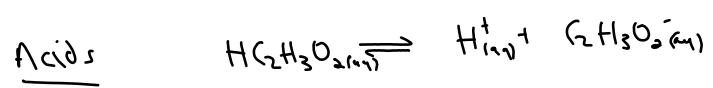
"weak" → don't completely ionize



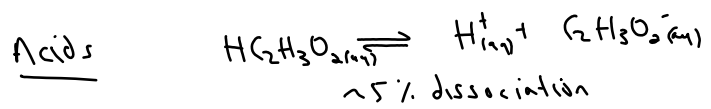
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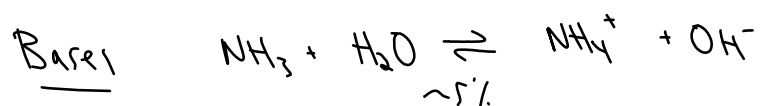
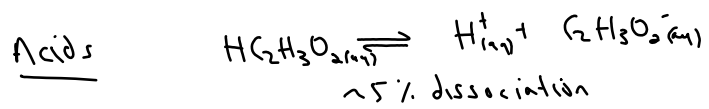
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Poly protics

acid w/ more than 1  $H^+$

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↳  $H_2SO_4$ ,  $H_2CO_3$

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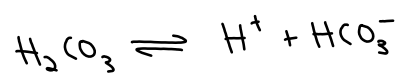
$H_2CO_3$

$H^+$  are given off 1 at a time



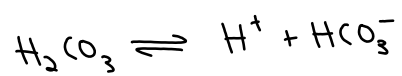
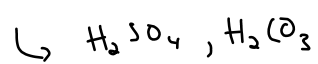
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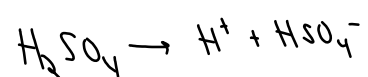


$H^+$  are given off 1 at a time

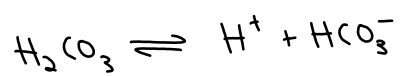
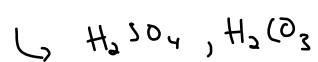
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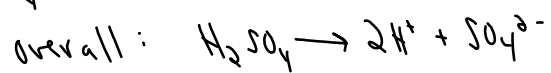
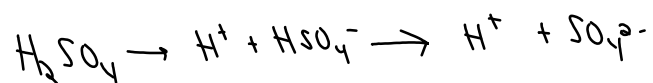
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## Ch 15-16 Notes G.ink

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Blank-Lowy  
Conjugate A/B Pairs

## Ch 15-16 Notes G.ink

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Bronsted-Lowry  
Conjugate A/B Pairs

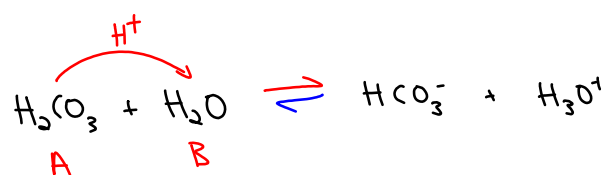


## Ch 15-16 Notes G.ink

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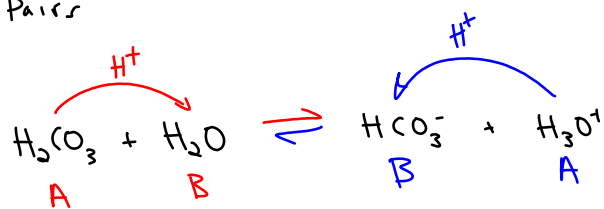
Bronsted-Lowry

Conjugate A/B Pairs



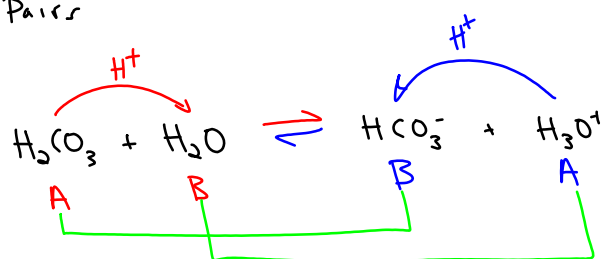
Bronsted-Lowry

Conjugate A/B Pairs

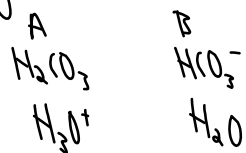


Brønsted-Lowry

Conjugate A/B Pairs



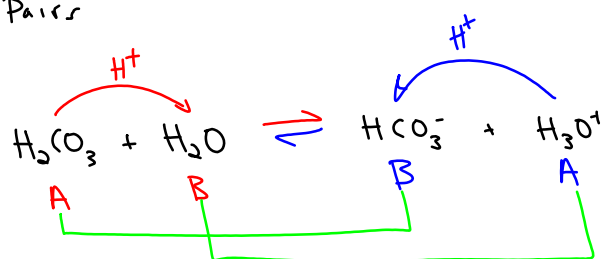
Brønsted-Lowry conjugate A/B Pairs



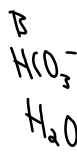
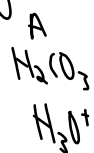


Brønsted-Lowry

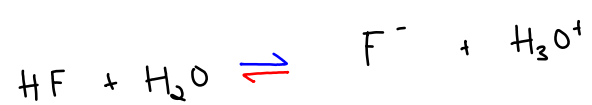
Conjugate A/B Pairs



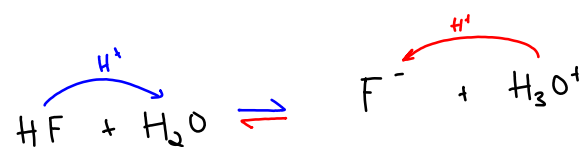
Brønsted-Lowry conjugate A/B Pairs

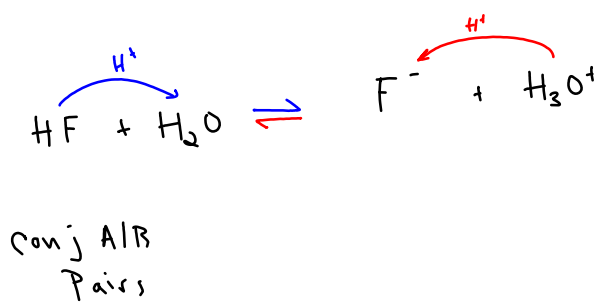


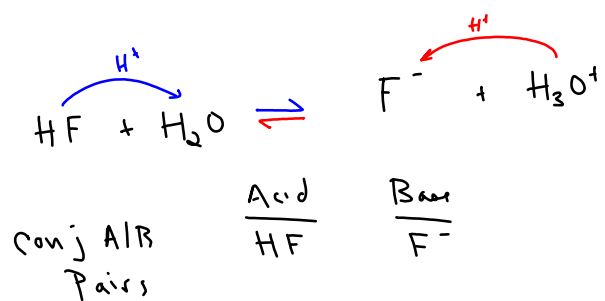
} differ by 1  $\text{H}^+$

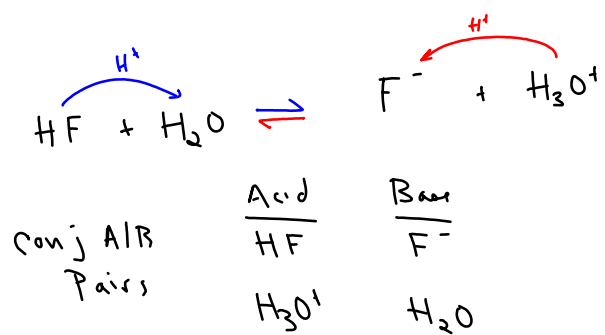


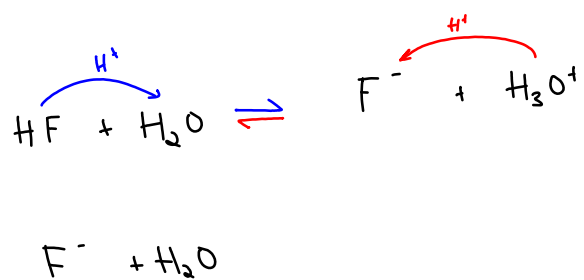




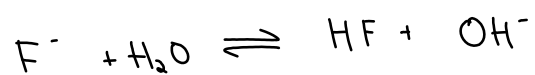
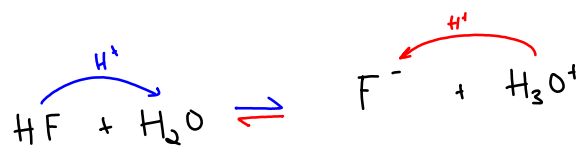












Strengths of Conj A/B

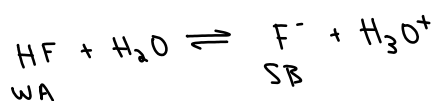
↳

Strengths of Conj A/B

↳ The stronger conj Acid,  
has a weaker conj Base (vice versa)

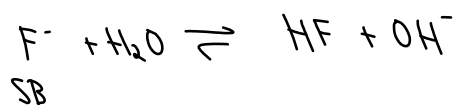
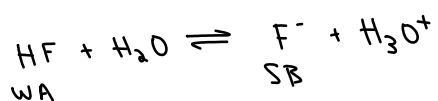
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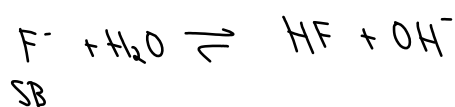
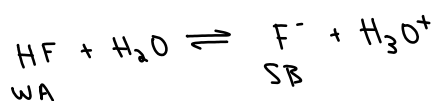
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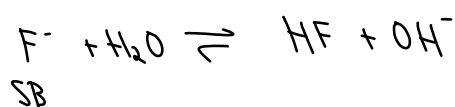
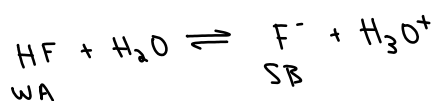
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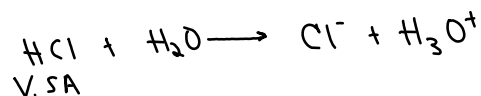
Stronger species  
is always favored  
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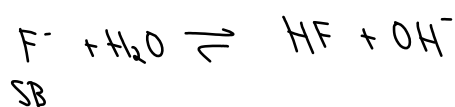
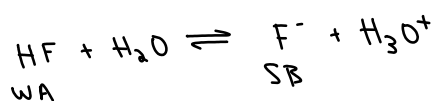


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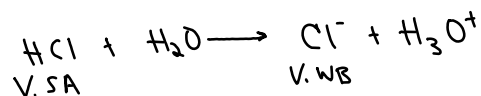


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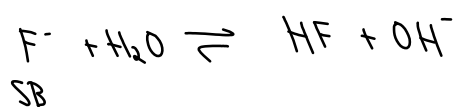
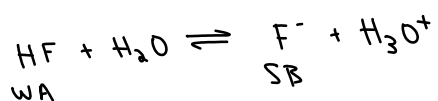
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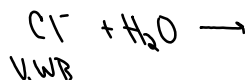
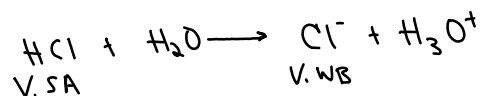


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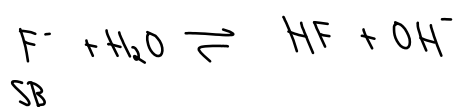
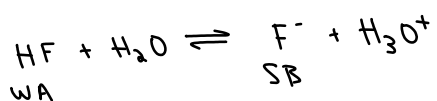


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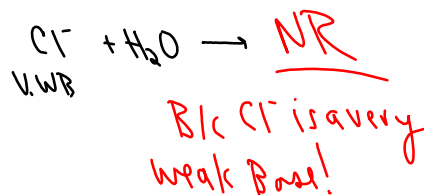
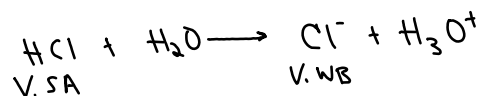


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Titration -

Titration - method to determine the [unknown] of a soln.  
using a soln of [known]

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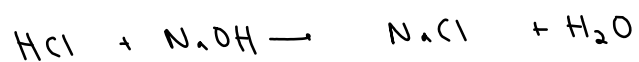
For Acid/Base Titrations → perform neutralization Rxns

## Ch 15-16 Notes G.ink

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Titration - method to determine the [unknown] of a soln.  
using a soln of [known]  
↳ standard soln

For Acid/Base Titration  $\rightarrow$  per form neutralization Rxns

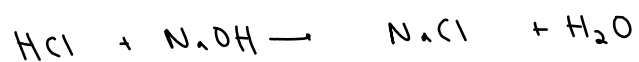


## Ch 15-16 Notes G.ink

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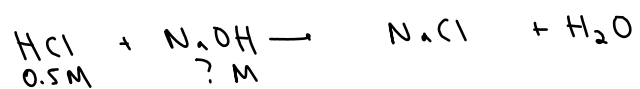


## Ch 15-16 Notes G.ink

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## Ch 15-16 Notes G.ink

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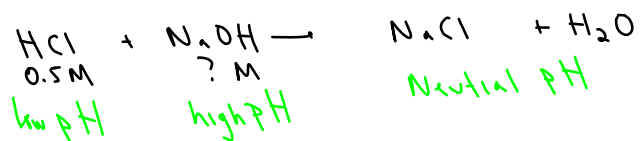


## Ch 15-16 Notes G.ink

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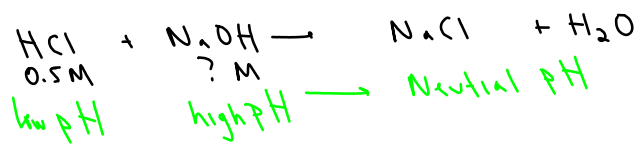


## Ch 15-16 Notes G.ink

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## Ch 15-16 Notes G.ink

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Titration - method to determine the [unknown] of a soln.  
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For Acid/Base Titration → per form neutralization Rxns



During titration the Acid + Base must  
to be in chemically equivalent amounts

## Ch 15-16 Notes G.ink

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using a soln of [known]  
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For Acid/Base Titration → per form neutralization Rxns



During titration the Acid + Base must  
to be in chemically equivalent amounts (this point pH = 7)

## Ch 15-16 Notes G.ink

---

Titration - method to determine the [unknown] of a soln.  
using a soln of [known]  $\rightarrow$  standard soln

For Acid/Base Titration  $\rightarrow$  per form neutralization Rxns



During titration the Acid + Base must  
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Equivalence Point

## Ch 15-16 Notes G.ink

Titration - method to determine the [unknown] of a soln.  
using a soln of [known]

↳ standard soln

For Acid/Base Titration → per form neutralization Rxns



low pH      high pH      → Neutral pH

During titration the Acid + Base must  
to be in chemically equivalent amounts (this point pH = 7)

→ Equivalence Point

↳ Point in Titration where  
 $\text{mol H}^+ = \text{mol OH}^-$



## Ch 15-16 Notes G.ink

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## Ch 15-16 Notes G.ink

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For Acid/Base Titration → per form neutralization Rxns



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↳ Equivalence Point

↳ Point in Titration where  
mol  $\text{H}^+$  = mol  $\text{OH}^-$

↳ This is seen by  
using an indicator  
that changes color  
at this point

## Ch 15-16 Notes G.ink

Titration - method to determine the [unknown] of a soln.  
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low pH      high pH  $\longrightarrow$  Neutral pH

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↳ Equivalence Point

↳ Point in Titration where  
 $\text{mol H}^+ = \text{mol OH}^-$

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using an indicator  
that changes color  
@ this point

End point - where a  
color Δ is

## Ch 15-16 Notes G.ink

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## Ch 15-16 Notes G.ink

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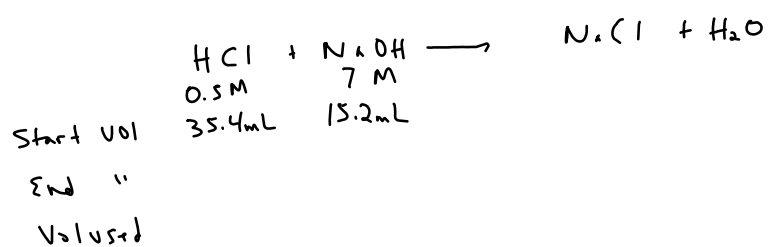
Start Vol

End "

Vol used

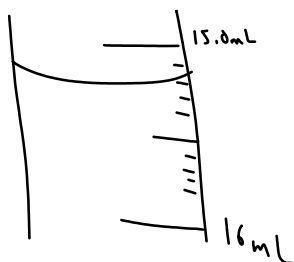
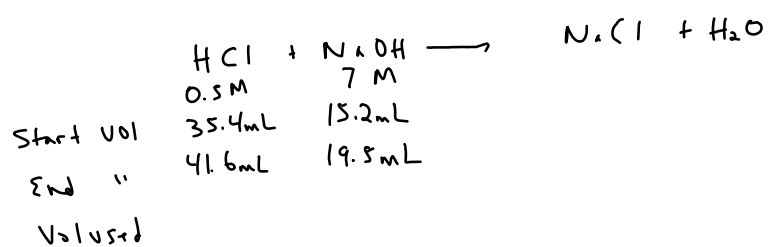
## Ch 15-16 Notes G.ink

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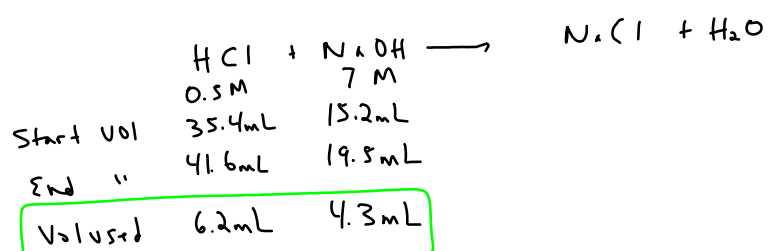
## Ch 15-16 Notes G.ink

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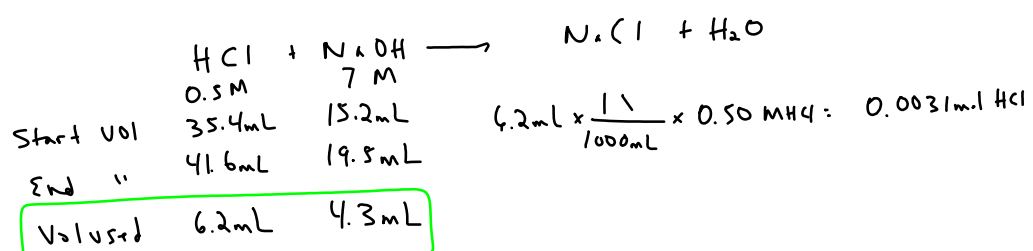
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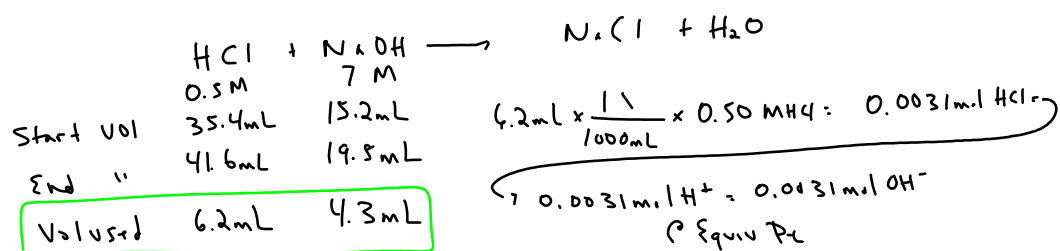
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	HCl	+	NaOH	→	NaCl	+	H <sub>2</sub> O
	0.5M		7M				
Start Vol	35.4mL		15.2mL				
End "	41.6mL		19.5mL				
Vol used	6.2mL		4.3mL				

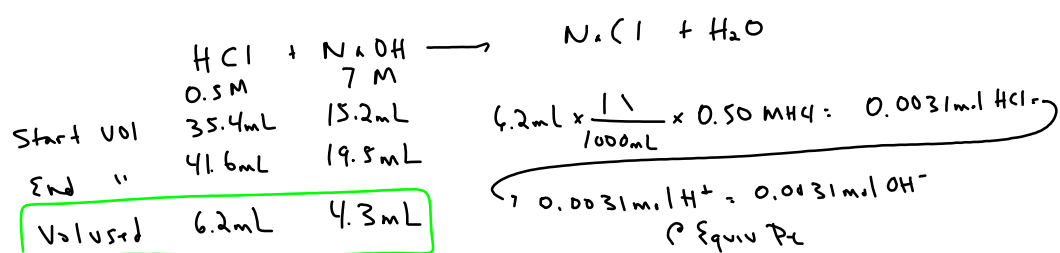
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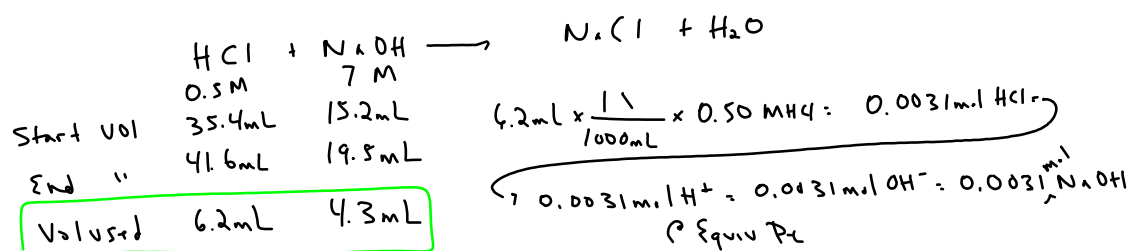
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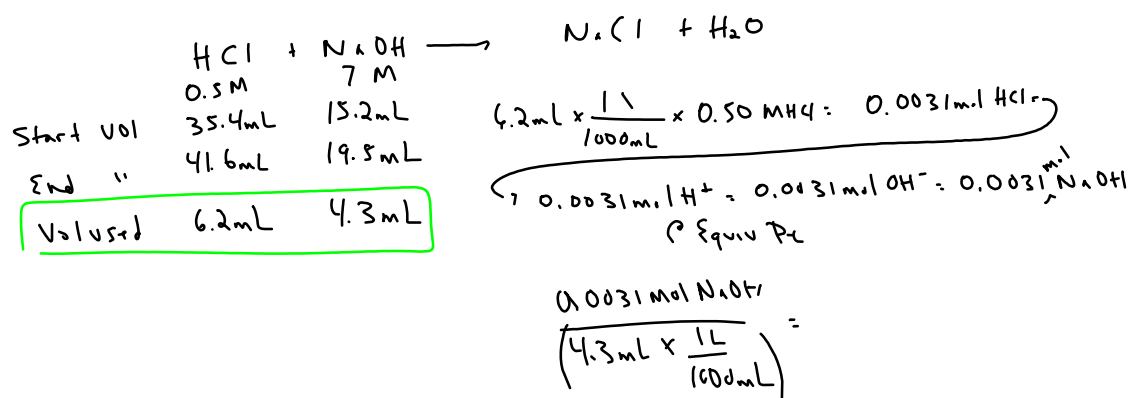


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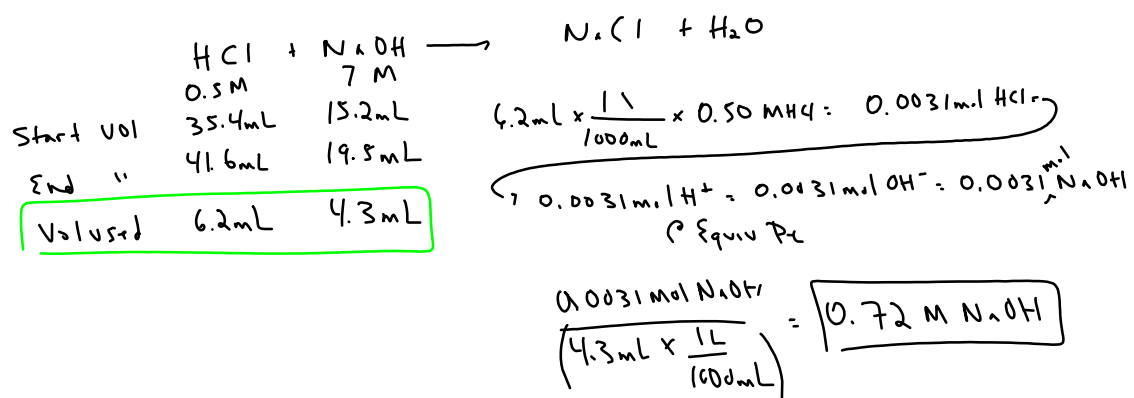




## Ch 15-16 Notes G.ink



## Ch 15-16 Notes G.ink



## Ch 15-16 Notes G.ink

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PH



## Ch 15-16 Notes G.ink

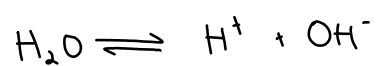
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PH

auto-ionization of  $H_2O$

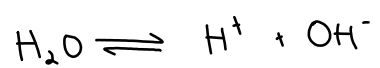
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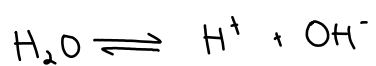


$$\text{In pure } H_2O \rightarrow [H^+] = 1.0 \times 10^{-7} M$$

$$[OH^-] = 1.0 \times 10^{-7} M$$

PH

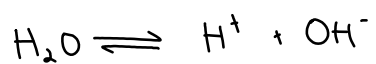
auto-ionization of  $H_2O$



In pure  $H_2O \rightarrow [H^+] = 1.0 \times 10^{-7} M$   
 $[OH^-] = 1.0 \times 10^{-7} M$  } 2  $[ ]$ 's are  
inversely prop.  
so  $H^+ \uparrow, OH^- \downarrow$

PH

auto-ionization of  $H_2O$



In pure  $H_2O \rightarrow [H^+] = 1.0 \times 10^{-7} M$

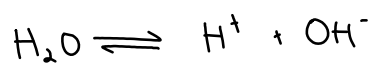
$[OH^-] = 1.0 \times 10^{-7} M$

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$$K_w = [H^+][OH^-]$$

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$$K_w = [H^+][OH^-] = 1.0 \times 10^{-14}$$

auto-ionization const  
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## Ch 15-16 Notes G.ink

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pH calc

## Ch 15-16 Notes G.ink

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$$\text{pH calc} \quad \text{pH} = -\log [\text{H}^+]$$



## Ch 15-16 Notes G.ink

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$$\text{pure H}_2\text{O} \quad \text{pH} = -\log (1.0 \times 10^{-7} \text{ M})$$

## Ch 15-16 Notes G.ink

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## Ch 15-16 Notes G.ink

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Strong Acids

0.0025 M HCl

pH = ?

## Ch 15-16 Notes G.ink

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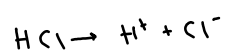
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Strong Acids

$0.0025 \text{ M HCl}$

$\text{pH} = ?$



$\frac{0.0025 \text{ mol HCl}}{1 \text{ L soln}}$

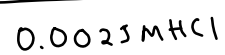
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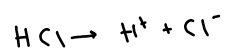
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Strong Acids



$\text{pH} = ?$



$\frac{0.0025 \text{ mol HCl}}{\text{L soln}} \times \frac{1 \text{ mol H}^+}{1 \text{ mol HCl}}$

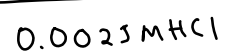
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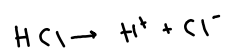
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Strong Acids



$\text{pH} = ?$



$\frac{0.0025 \text{ mol HCl}}{\text{L soln}} \times \frac{1 \text{ mol H}^+}{1 \text{ mol HCl}} = 0.0025 \frac{\text{mol H}^+}{\text{L}}$

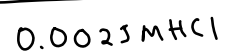
## Ch 15-16 Notes G.ink

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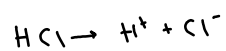
pH calc     $\text{pH} = -\log [\text{H}^+]$

pure  $\text{H}_2\text{O}$      $\text{pH} = -\log (1.0 \times 10^{-7} \text{ M})$   
 $= 7$

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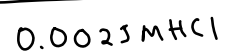
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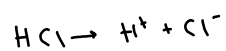
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Strong Acids



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$\text{pH} = -\log (0.0025 \text{ M}) = 2.60$



weak acid

## Ch 15-16 Notes G.ink

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Weak acid → don't completely  
ionize

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0.0025 HF (10% dissociation)

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pH of Bases

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0.0034 M NaOH

$$\hookrightarrow [OH^-] = 0.0034 M$$

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$$[H^+] = \frac{1.0 \times 10^{-14}}{0.0034 M} =$$

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## Ch 15-16 Notes G.ink

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$$pH = -\log(2.94 \times 10^{-12} M) = 11.54$$

$$K_w = [\text{H}^+][\text{OH}^-]$$

$$-\log K_w = -\log [H^+][OH^-]$$

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$$14 = -\log([H^+][OH^-]),$$

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$$14 = pH + pOH$$